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as it is of the gains or loses on a cock fight. Remedies for snake poison abound as in other countries. One old Indian who had been to Manila and had dabbled in drugs, assured us that if he could reach the person bitten before he was quite dead he could save him by applying muriatic acid. The flying lizard, *Draco*, found here differed from those we had collected in other parts, in its larger size, and in having the under surface of the membranes bright red in color.

At the end of the month devoted to Samar and Leite, we found a little brig, built in the Philippines, and commanded by a Spaniard, loaded with manila hemp and bound for Manila. Making a bargain with the captain to land us on the island of Masbate, which lay very close to his route, we hurriedly gathered our collections and luggage together, and embarked.

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## ON THE DEVELOPMENT OF CALIFORNIA FOOD FISHES.

C. H. EIGENMANN.

FROM a biological standpoint the Surf Perches are the most interesting of the California fishes. The species inhabiting the shores of California are probably all well known, and the later stages of their larval development have been well treated by Agassiz, Blake and Ryder. Dr. Charles Girard was able to examine younger stages than the other writers, but he did not contribute much to our knowledge of them. Until now the ripe eggs and embryos of these fishes have not been seen. During the past two months, December and January, I have been enabled to examine many individuals of almost all the species found in San Diego Bay. In most of them I have found embryos or ripe eggs. *Micrometrus aggregatus*, on account of its abundance, the ease with which it can be caught, and the fact that different individuals of the same date have young in widely different stages of development, has proved to be the

most interesting of the species. An account of it will serve for all the others. As is well known, the egg-bearing lamellæ are broad sheets which are suspended from the roof of the ovary; there are usually three of these sheets in each half of the ovary. The eggs are very small (.2 mm.) as compared with the eggs of other fishes: they protrude from the lamellæ much as other fish ova do and they seem to be surrounded by a more transparent area. I have seen the eggs of several species but for lack of proper facilities to study the material collected a more detailed description cannot be given at present. The eggs of *Micrometrus aggregatus* have the yolk collected in spherical masses, and there seems to be no oil globule, while the eggs of *Ditrema jacksoni* have from one to three oil globules. Whether the eggs are fertilized before they are freed from the lamellæ, I cannot state at present; long before hatching, the eggs are found lying in the folds of the ovary. The eye is much less conspicuous than in other fish embryos, and the hypertrophied hind gut is developed before hatching. In larvæ in which the mouth was apparently not yet formed, the vent was open and the vigorous peristaltic action which was confined to the hind gut began at the vent and traveled forward; this would seem to make it probable that food is taken in through the vent in the earliest stages of the larval existence. A structure whose significance has not yet been determined is found in larvæ less than half an inch long. It consists of a spirally twisted, opaque white substance lying free in the hind gut; it terminates posteriorly in a knob; its anterior connection has not been traced. During the peristaltic movement mentioned, this spiral moves freely, and in several instances it was entirely withdrawn from the hind gut, the knob at its posterior extremity seeming to form a partial plug at the anterior end of the posterior intestine.

The first indications of the peculiar prolongations of the vertical fins was noticed in larvæ an inch long; all the fins were well developed and the interradian membranes projected as short, broad flaps beyond the tips of the rays.

The Herring, *Clupea mirabilis*, enters the bay of San Diego

in great numbers during December and January. The eggs are very adhesive when first deposited, but half an hour after deposition they lose their stickiness and remain free when loosened. The yolk is collected in spherical masses. The protoplasm is yellow, and the formation of the germinal disk can readily be watched. Strands of the protoplasm can be seen extending from it into the yolk. The first cleavage furrow is formed about two hours after fertilization, and the first cleavage occupies about forty-five minutes. The furrow travels slowly towards the base of the germinal disk, which it reaches in about twenty-eight minutes; at this stage the two newly formed cells seem well separated. As soon as the furrow has reached the base of the disk it begins to retreat, leaving but a line to separate the two cells. When the furrow has entirely retreated, the division of the two cells is not very plain, and the second furrow is immediately formed. The division of the disk into four cells is more rapid than its division into two. The further development very much resembles that of the shad as it is described by Ryder; it is, however, much slower. The blastopore closes about thirty hours after segmentation. The heart is formed near the close of the second day. Kupfer's vesicle appears about fifty hours after fertilization. On the sixth day one shell was found, but the escaped fish could not be seen. Other embryos continued to be active in the shell five days longer, when they died.

The Smelt of California, *Atherinopsis californiensis*, is one of the most abundant of the food fishes. It enters San Diego bay in December to spawn. The eggs are large and transparent, and, during the earlier stages of development the oil is distributed in a number of globules, while in a later stage but a single oil globule is present. Each egg is provided with about ten long filaments which differ somewhat from those of *Fundulus*. The base of each filament is enlarged, disk-shaped and apparently hollow, and the substance of the zona seems to enter it. The filaments are uniformly distributed over the surface of the egg, and in the ovary they are coiled around the egg in one direction only.

The eggs were artificially fertilized ; after three hours twenty-five minutes, the first cleavage was completed. Twenty minutes afterwards four cells had been formed. The time of the development of the other phases may be best tabulated :

16 cells.....	4 h. 45 min. after fertilization.		
32 cells.....	5 h. 10 min. “	“	“
First horizontal furrow.....	6 h. “	“	“
Beginning of blastula stage.....	28 h. “	“	“

At this stage the free nuclei are very abundant and cover about half the yolk. They are much larger and more numerous just at the edge of the blastula. The blastula stage lasts less than half an hour; the embryonic shield is first seen forty-one hours after fertilization. Two and a half days after fertilization the optic vesicles appear. The blastopore closes after about eighty hours. Kupfer's vesicle and the myotomes appear on the fourth day, the heart on the seventh day; on the twelfth the embryos move vigorously; on the sixteenth day pigment spots appear on the top of the head and along the median line of the back. The water space which at first was inconsiderable has greatly increased. The embryos were at this time near hatching, but, unfortunately died.

Some larvæ of this species procured afterwards show the following pigment spots: A series along the median line of the back from the occiput to the caudal fold; a spot above the posterior portion of each eye; one medially above the front of the eye; a small one at the nares. A series of spots along the median line of the sides; numerous spots over the air-bladder and upon the abdomen. Later a series is formed along the base of the anal fold. Yellowish dots are found between the black pigment spots of the back and sides. These larvæ have a continuous fin fold from the abdominal region of the back around the tail to the vent; a smaller fold in front of the vent. The embryonic rays are most numerous and best developed at the tail. The caudal shows heterocercal tendencies.